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Vorticity equation for gyrokinetic formulations[1] FELIX I. PARRA, PETER J. CATTO, Plasma Science and Fusion Center, MIT, Cambridge, MA — Traditionally, a gyrokinetic quasineutrality equation has been employed to calculate the electric field in delta-f gyrokinetic codes. The usual gyrokinetic quasineutrality is written to first order in an expansion in the ion Larmor radius over the tokamak minor radius, and it provides the correct result for short wavelengths, on the order of the ion Larmor radius. However, in tokamaks, this lowest order equation fails to give a self-consistent radial electric field for long wavelengths. To calculate the radial electric field, we need the toroidal rotation and hence we must keep the radial transport of toroidal angular momentum. This effect is missing in traditional gyrokinetics. By studying the time derivative of quasineutrality, known as the vorticity equation, we make explicit the effect of momentum transport and we prove that gyrokinetics has to be solved to higher order if the radial electric field is to be calculated from quasineutrality. As an alternative approach, we propose to employ a vorticity equation where only the terms that transport toroidal angular momentum must be calculated to higher order.

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